

# PATENT SPECIFICATION



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## PROVISIONAL SPECIFICATION.

Improvements in or connected with Apparatus for Separating Solid Particles from Air Employed for Carrying Off said Particles from Machinery or Processes in which they are Produced or Given Off.

We, THOMAS ROBINSON & SON, LIMITED, of Railway Works, Rochdale, in the County of Lancaster, Engineers, CHARLES JOHN ROBINSON, of Railway Works, Rochdale, aforesaid, Engineer, and THOMAS JOHN STEVENSON, of Railway Works, Rochdale, aforesaid, Engineer, do hereby declare the nature of this invention to be as follows:—

10 This invention has reference to apparatus or machinery for separating solid particles from air employed for carrying off such particles from machinery or processes in which they are produced or given off, the movement of the air being effected by a fan or like on or connected with the separating machinery; and it relates more especially to cases wherein the solid particles given off from the substances being operated upon or treated are more or less large or coarse, as well as fine, they being taken hold of by and carried away with the current of air produced by the suction or minus pressure created by said fan or the like. Examples of such cases are wood working machines such as planers, saws, boring machines, *etcetera*, where chips or large pieces, as well as fine particles, are produced or given off; but the invention can also be used advantageously in connection with machinery such as sand-papery and like machines; and

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other examples of its applicability are cases where husks or shells of seeds or grain chaff are given off from the material being operated upon, and other industrial operations or processes of a similar nature.

The invention consists partly in the application and use of valvular means as hereinafter described, to and in connection with the carrying off of solid articles or particles—more particularly of a relatively large size—in industrial processes or machinery of the kinds referred to by air, and the separation and deposit of same from the air by which they are so carried from such machinery or processes.

In the apparatus hereinafter described, and its application and mode of operation, the improvements under this invention are comprised.

The separating apparatus employed is of the type known as "Cyclone" separator, generally comprising a part in which the air carrying the solid particles is introduced into a cylindrical body, more or less tangentially, and thereby centrifuged, and the air is carried away from the centre of same, whilst the particles heavier than air, strike or come near the sides, and so become separated and fall down into a conical or like body below, from which they are trapped out by a mechanical trap arrangement adapted to

effect the discharge from the separator, and exclude the entrance of air; and the pressure of air in the apparatus is below that of the atmosphere; and further the preferred type of such separator apparatus is that known of the duplex cyclone kind in which the air which is caused to enter one and be delivered from it, is discharged into the cylindrical part of another in the same manner as it entered the first, and the air ridded of solid contents, is discharged in the atmosphere. The heavier and larger particles are adapted to be deposited in the first apparatus, and the lighter or finer in the second; and the inlet conduit of the first separator will lead from the machinery in which substances are being operated upon, and particles both coarse and fine are being given off or produced and taken up by the air.

The valvular apparatus for the discharge of the separated and deposited substances, and more particularly the larger sort, consists of two flap valves arranged on the bottom or lower part of the separator, one below the other, and operated in sequence, so that when one is open the other is closed, and *vice versa*; and these valves are inclined from one end at which they are hinged, and about which they work in a circular direction, to the lower end, at which point the material will be discharged by gravity.

The flap valves proper—which are both placed and work in a common chamber—are not directly connected with their operating shaft or spindle at the upper or back end near the pivot, but are operated through a spring, one end of which is connected to the shaft or spindle, and the other end is connected to the valve near or towards the outer edge by a pivot joint; the back edge of the valve being supported by a cylinder or part carried on the shaft or spindle, so adapted that when the valve is closed—which it will be preferably effected by a weight or spring—the back or upper part will lie on the face of the opening or spout in connection with which it works. By means of the flexible connection and mode of operating the valve, the valve is readily made to bear on the whole face or seat on which it works with the required equality of pressure, and in this sense it is self-adjusting on its seat.

One means of operating these valves alternately consists of two tappet arrangements, which alternately operate upon bars or arms, or levers, at or connected with the valve axles or spindles, as the case may be, one only of the tappets

being in positive operation at the one time; and these two tappet arrangements may be connected together, and worked by gearing, say chain gearing, and consists of discs or cranks with pins or projections in them, set oppositely in the different discs or cranks, and adapted to come in contact with and operate the separate bars or levers of the mechanism during less than one half of their revolution, and disengaged or free therefrom in the other or greater half.

By this means the alternative opening and closing of the two valves will be accomplished advantageously and simply; and so that say when the bottom valve is closed, the upper one is open, the material which has collected on the form or the spout in connection with which it works, will fall down into the chamber below, and on to the lower valve; and then it will close and so seal the apparatus; and the lower valve will be opened and allow the material upon it to discharge; after which this valve closes, and so on. Also by this arrangement a partial vacuum or minus pressure is more easily maintained in the separating chambers.

With regard to the valve spindle or shaft operating gear, this may be rotated or moved circularly in the manner described, and have over it a sleeve inside of which the upper end of the valves rest in the manner specified.

The valves will be preferably faced with rubber or like material, which assists in effecting an air tight closure or sealing of the valves and their seats.

In one arrangement the upper valve is smaller than the other in order to overcome more readily the resistance of the atmospheric pressure against which it opens, and which will exist in the valve chamber between the two valves; whilst the bottom valve being larger, assists in the discharge of the collected material.

In some cases this flap valve arrangement will be used in connection with each of the separating portions of the twin cyclone apparatus; whilst in other cases it may be used in connection with one of the vessels, *viz.*, that in which the coarse particles are separated and collected, and an ordinary rotary type of trap discharge mechanism used in connection with the other.

Dated this 15th day of May, 1919.

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## COMPLETE SPECIFICATION.

**Improvements in or connected with Apparatus for Separating Solid Particles from Air Employed for Carrying Off said Particles from Machinery or Processes in which they are Produced or Given Off.**

We, THOMAS ROBINSON & SON, LIMITED, of Railway Works, Rochdale, in the County of Lancaster, Engineers, CHARLES JOHN ROBINSON, of Railway Works, Rochdale, aforesaid, Engineer, and THOMAS JOHN STEVENSON, of Railway Works, Rochdale, aforesaid, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention has reference to apparatus or machinery for separating solid particles from air employed for carrying off such particles from machinery or processes in which they are produced or given off, the movement of the air being effected by a fan or like on or connected with the separating machinery; and it relates more especially to cases wherein the solid particles given off from the substances being operated upon or treated are more or less large or coarse, as well as fine, they being taken hold of by and carried away with the current of air produced by the suction or minus pressure created by said fan or the like; and air discharged from the part of the apparatus wherein the particles are deposited, by a duplex flap valve type of discharge appliance. Examples of such cases are wood working machines such as planers, saws, boring machines, *etcetera*, where chips or large pieces, as well as fine particles are produced or given off; but the invention can also be used advantageously in connection with machinery such as sand-papering and like machines; and other examples of its applicability are cases where husks or shells of seeds or grain chaff are given off from the material being operated upon, and other industrial operations or processes of a similar nature.

According to this invention the duplex valvular means for discharging the deposited solid articles or particles—more particularly of a relatively large size—consists of two interconnected flap valves arranged on the bottom or lower part of the separator vessel, one below the other,

and adapted to operate in sequence, as hereinafter described, so that when one is open the other is closed, and *vice versa*.

The separating apparatus employed comprises a part in which the air carrying the solid particles is introduced into a cylindrical body, more or less tangentially, and thereby centrifuged, and the air is carried away from the centre of same, whilst the particles heavier than air, strike or come near the sides, and so become separated and fall down into a conical or like body below, from which they are trapped out by a mechanical trap arrangement adapted to effect the discharge from the separator, and exclude the entrance of air; and the pressure of air in the apparatus is below that of the atmosphere; and further the preferred type of such separator apparatus is that in which a duplex separator of the type referred to is used, in which the air which is caused to enter one and be delivered from it, is discharged into the cylindrical part of another in the same manner as it entered the first, and the air ridded of solid contents, is discharged in the atmosphere. The heavier and larger particles are adapted to be deposited in the first apparatus, and the lighter or finer in the second; and the inlet conduit of the first separator will lead from the machinery in which substances are being operated upon, and particles both coarse and fine are being given off or produced and taken up by the air.

The invention will be further described with reference to the accompanying drawings, in which Figure 1 is an outside elevation of a duplex separator, Figure 2 is a vertical section of the valvular apparatus; and Figure 3 a cross section of the latter.

In the drawing, 1 is the first portion of the separator, and 2 is the second portion. 3 and 4 are the exhausting fans, on the upper parts of these two portions, respectively; 5 and 6 are the respective cylindrical portions of the separators; 7 and 8 are the respective conical bottom portions; and 9 and 10 are the valvular discharge appliances on the bottoms of the

depositing cones of which 9 is shown in detail in Figs. 2 & 3.

11 is the conduit by which the air containing solid particles produced or given off from machinery or a process is conducted to the separator; and it may be assumed that the variations in size, in some cases are great, such as in cases where chips small and large, as well as dust or finer particles are given off in wood working machinery. The conduit 11, leads tangentially into the upper cylindrical part 5 of the separator apparatus 1, wherein the chips or larger particles referred to will be separate from the air; and 12 is the discharge conduit from the fan 3 which conducts the air discharged from separator 1 tangentially into the cylindrical chamber 6 of separator 2, in which dust and the smaller particles will be separated and deposited.

The air then ridded of the dust and solid particles is discharged through the conduit 13 by the fan 4.

It will be noticed that the size of the separator 2 is much larger than the separator 1. The pressure of air in both the separate portions 1 and 2 is maintained below that of the atmosphere. A duplex separator of the general kind herein-described, is set forth in the Specification of our Patent No. 1560 of 1915 and we make no general claim to same hereunder.

With regard to the valvular arrangement shown in Figures 2 and 3, the valves 15 and 16 are not directly connected with their operating shafts 17, 18, but are operated through spring levers 19, 20, respectively, the ends of which are connected to shafts 17, 18 respectively, and the other ends are connected to the valves towards their outer edges, by hinge joint connections 21 and 22 respectively, and at a point or points within the perimeter or area of the seat or space which the valve flap closes. The back edges of the valves 15, 16 are supported by cylinders 23, 24 carried on the shafts 17, 18, and so adapted that when a valve is closed, the back or upper part of it will lie on the seat in connection with which it works, the seat in case shown being formed of sides, and upper and lower boards 25.

The valves are normally pressed on to their seats by weighted levers 26, fixed on the valve spindles 17 and 18; and the whole valvular arrangement is disposed within a trunk or casing 30, in which the valves occupy a reduced or constricted space in the trunk thus forming a kind of hopper or chute above each valve flap.

By means of the flexible connection and mode of operating the valves, they are readily made to bear on the seat on which they work, with the required equality of pressure, and in this sense they are self adjusting on their seats.

The means of operating the valves alternately, in the case shown, consists of two tappet arrangements which alternately operate upon bars or arms 31 connected with the valve shafts 17, 18, through the short arms of the weighted bell crank levers 26; one only of the tappets being in positive operation at the one time. The tappets each consists of a toothed disc 32, fixed on a spindle 33, geared and operated together by means of a chain 34, working over the teeth on the edge of the discs 32, each disc having a pin 34 on it which operates in connection with a recess 35 on the ends of the levers 31; the parts being so arranged that the pins operate upon the levers 31 during less than half their revolution, in which part of their motion the valves are opened; and then afterwards, leaving the recess, the pins allow the valves to be closed by their weighted levers, the parts being so arranged that when one valve is closed the other is open.

To relieve the strain on the spring levers 19, 20 when operating the valves 15, 16, a rod 36 is employed in connection with each valve, and is operated longitudinally in its bearing by a cam 37 on the spindle 33 which acts upon a bolt at the outer end of the rods. These rods act on the end of the flap valve 15, 16 which are furthest from the operating spindles 17, 18, which are the pivots of the valves, and so enable them to operate with the least expenditure of effort in overcoming the counter pressure of the air acting upon the under side of the valves, tending to keep them closed on their seats against the mechanical pressure produced by the tappet gear and spring levers 19, 20. After a rod 36 has sufficiently opened the valve, so as to cause the pressure on both sides to equalize the spring lever 19 or 20, thereof comes into action, and opens the valve to its fullest extent with a minimum strain.

By this form of valve arrangement, the amount of pressure upon them is minimised, and the maximum vacuum within the separators is preserved.

The rods 36 are normally pressed outwards towards their operating ends by spring 38. Where the upper ends of the spring levers 19, 20 come, the spindles 17, 18 are each provided with a flat sided block as shown, to which their ends are

attached; the cylinders 23, 24 being mounted on the shafts 17, 18 on each side of the blocks.

The valves are preferably faced with rubber or like material, which assists in effecting an air tight closure or sealing with their seats.

In Figure 1 the flap valve arrangement is only shown fitted to the first separator 1; but it may be fitted to both the separators if desired. The valve fitted to the separator 2 in the case shown, is of the rotary trap valve type.

Having now particularly described and ascertained the nature of our said invention, and in what manner the same is to be performed, we declare that what we claim is:—

1. In the separation of solid particles from air employed for carrying off said particles from machinery or processes in which they are produced or given off, the employment of duplex interconnected and operating flap valves; substantially as set forth.

2. In the separation of solid particles from air employed for carrying off said particles from machinery or processes in which they are produced or given off, and the discharge of said particles is effected by duplex interconnected and operating flap valves, a duplex separator apparatus of the kind herein specified, adapted to cause the separation and deposit from the air of the relatively large particles in the first apparatus, and the separation and deposit of the smaller particles and dust in the second apparatus, the said duplex valves being em-

ployed in the first apparatus; substantially as set forth.

3. Separating apparatus of the kind specified in Claiming Clause 1, wherein the valves are moved on to their seats and held by a spring lever connected with the valve flap at a point within the perimeter or area of the seat or space which the valve flap closes; substantially as set forth.

4. Separating apparatus of the kind specified in Claiming Clause 1, wherein the valve is moved off its seat by means acting on the outer end thereof, said means operating in conjunction with the main mechanism by which the valves are mechanically pressed away from their seats and closed, by means which operate from a pivot remote from that which the said valve is mounted on; substantially as set forth.

5. Separating apparatus of the kind specified in Claiming Clause 1, having a separate tappet mechanism adapted to operate each valve mechanism, and to open the valve; said mechanism being adapted to open the valve in one part of its stroke, and to move away from same in the other portion of the stroke, and allow it to close; substantially as set forth.

6. Separator valvular mechanism substantially as described and shown in the drawings.

Dated this 17th day of November, 1919.

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FIG. 1.

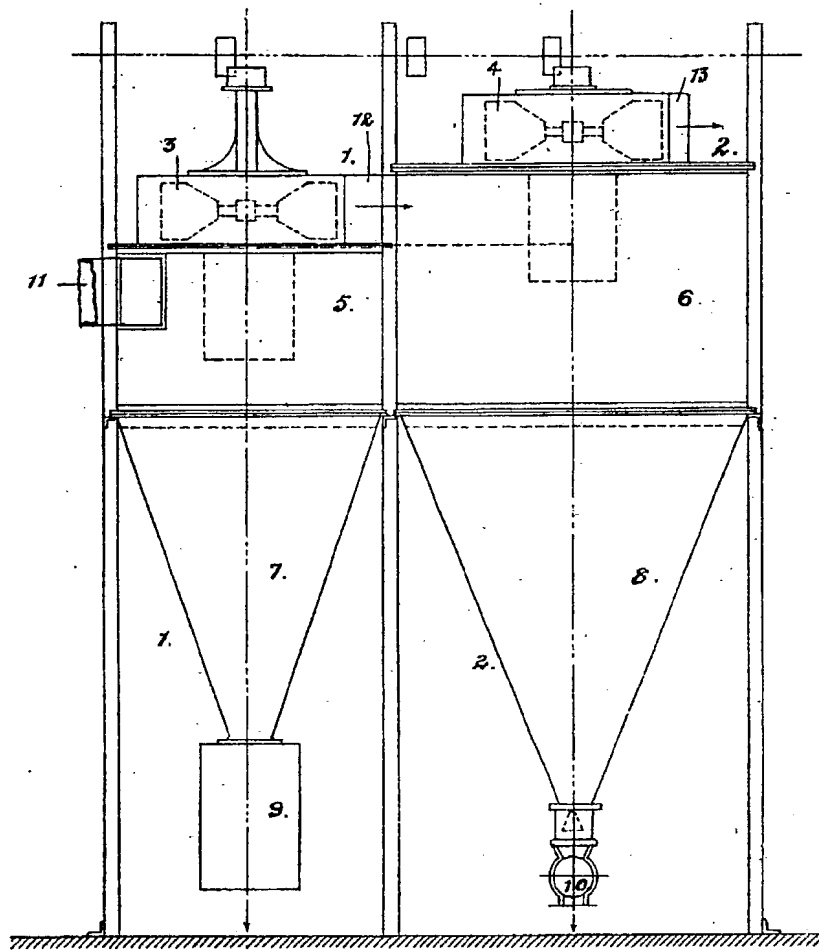


FIG. 2.

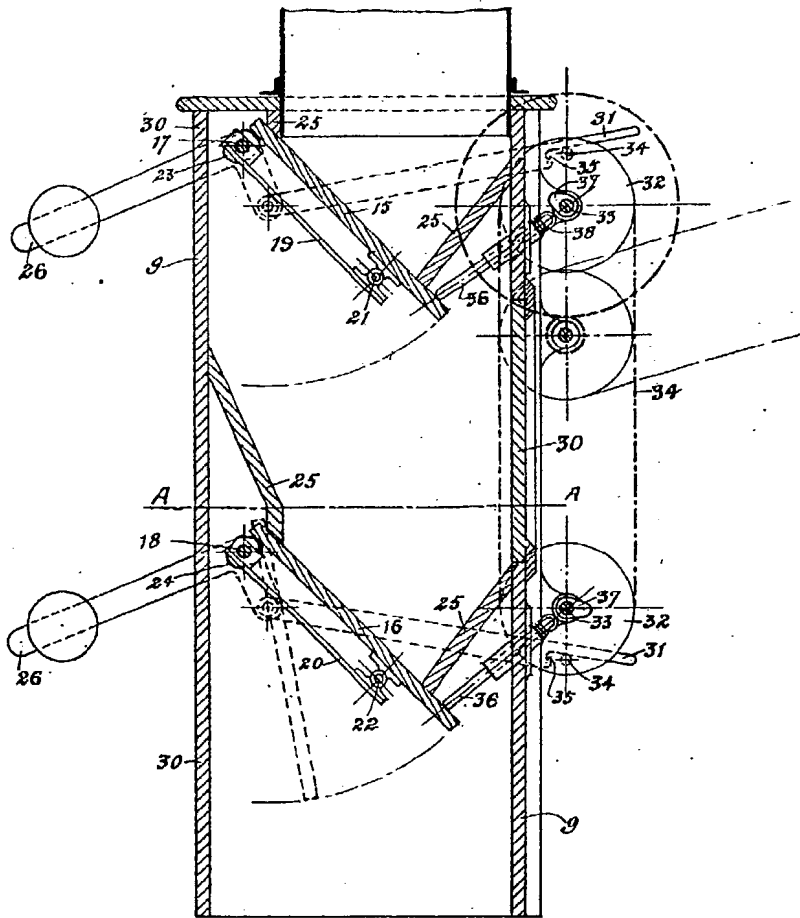


FIG. 3.

